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Comparison Study on Travel Characteristics between Two Kinds of Electric Bike

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Abstract

Electric two-wheeler is booming in China, and there are two kinds of electric two-wheelers. One is electric bike, another is over-standard electric bike. Nowadays, over-standard electric bikes that account for 60 percent of electric two-wheeler become the major part. However, they have caused a series of problems affecting the traffic efficiency and safety. In order to take effective and practicable measures to supervise over-standard electric bikes, it is necessary to research it. In this paper, RP survey is used to approach to travel characteristics of over-standard electric bikes. Conclusion shows that over-standard electric bicycles have strong competitiveness with public transport and bicycle. The users prefer to a longer travel distance commuter trip. If over-standard electric bikes will be unavailable, users may travel by motorized traffic.

Keywords: Over-standard electric bike; Electric bike; RP survey; Travel characteristic;

1. Introduction

Electric two-wheeler use has skyrocketed in China over the past decade. Electric two-wheeler is a special category of vehicles in China that includes electric bikes and over-standard electric bikes. As the city grew, so did the transportation. To accommodate this demand, motorized traffic were experiencing tremendous growth. Because of reducing pollution and improving safety, many Chinese cities had banned or restricted motorcycles and gasoline-fueled scooters using a variety of measures, such as Shanghai, Nanjing, Guangzhou, etc. These motorcycle and scooter bans became the ultimate dynamic for the electric two-wheeler boom in China. Electric two-wheelers are also promoted by many local governments due to its low energy consumption and zero emissions, especially in China's congested urban areas. Under such background, the number of electric two-

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wheeler ownership has increased rapidly because it provides an inexpensive and convenient form of private mobility. According to the comprehensive traffic survey of Shanghai, the electric two-wheeler is booming in Shanghai, which is shown in figure 1.The number of electric bicycle ownership was 408 thousand in 2003, while 2797 thousand in 2012.

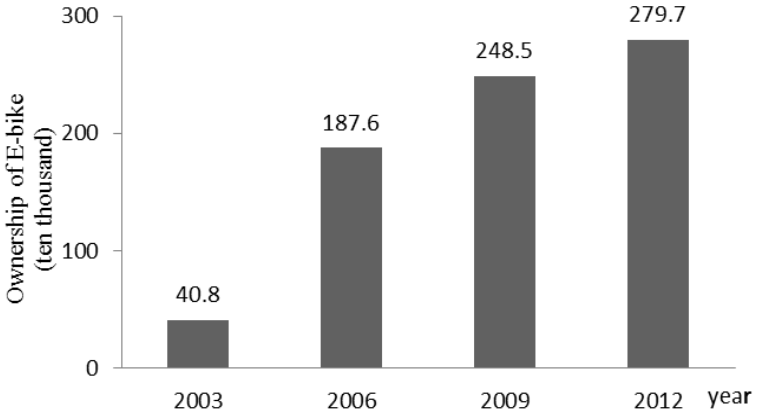

Fig. 1. Growth of electric bike ownership in Shanghai

Continuous increasing of electric two-wheeler starts to cause problems. The main reason is the existence of over-standard electric bicycles. The definition of over-standard electric bike is that the speed and weight index exceed standard of country(CHINA, 1999; DONG, 2003). The normal index of speed and weight is 20km/h and 40kg respectively. From a regulatory perspective, electric two-wheeler was classified as non-motorized vehicles and managed in the same way as traditional bicycles. There is a bad effect on the mixed traffic flow due to the difference of speed and size.

Nowadays, over-standard electric bikes are gaining an increasing share of electric two-wheeled transportation throughout China, and in most of cities have even surpassed electric bike mode share. At the same time, they provide an attractive alternative to e-bikes or regular bicycles. Compared with normal electric bike, the over-standard electric bikes have both positive and negative attributes.

First pros is the longer travel distance, and the second is the less driving time. The last but not the least is the comfortable driving conditions. On the other hand, over-standard electric bikes disrupt traffic and are prone to accidents. It is heavier and quite faster than e-bikes or regular bicycles. Three kinds of traffic with differences in speed operating on the same facilities will lead to a complicated mixed traffic flow and cause a series of safety problems. Stronger flexibility and faster speed lead to a higher avoidance rate of the over-standard electric bikes (Christophel, 2007).

Due to these problems caused by over-standard electric bike, several cities have sought to ban the whole electric bikes (CHEN, 2002). Compared with banning electric bikes in Guangzhou, Zhuhai, Taiwan officials promoted and even subsidized electric bike to instead of gas powered scooters (YANG, 2010). Some cities choose to neither support nor ban them.

On the conclusion, electric bikes are booming in China. This boom was triggered by Chinese local governments' efforts to restrict motorcycles in city centers to avoid traffic disruption and accidents. There is a kind of electric bike that is virtually motorcycle, but they are equipped with pedals to qualify as bike. The research of these over-standard electric bikes is in the vacuum. The traffic efficiency and characters are investigated in this paper.

2. Methodology

2.1. Survey method

There is little study status of use at home and abroad of over-standard electric bikes. The researchers focus on the electric bikes efficiency that electric bikes and bicycles are mixed and managed in the same way (CHEN, 2011; CHEN, 2012). The results have certain significance for us.

The main method to study over-standard electric bike is statistical analysis, such as mathematical statistics, discrete choice analysis and experimental analysis. The main method to collect data is RP survey (Revealed Preference survey) and SP survey (Stated Preference survey). Data from RP survey shows the actual users' feature, and from SP survey represents the users' choice through designing a hypothetical scene (ZHANG, 2006; Cherry, 2006; DONG, 2008).

Revealed Preference survey and Stated Preference survey is the commonest method to get basic data. Due to the deviation with the real situation, we just choose SP survey to study transportation modal choice, rather than over-standard electric bikes users' and trips' characters. In the paper, RP survey is selected to collect characteristics data.

2.2. RP survey in Shanghai

Electric two-wheeler users were selected as the object, and vehicle characteristics, features of user and travel characteristics were obtained by random sampling questionnaire survey. The respondents include all classes, such cleaners, white collar, students, etc.

Investigations were arranged in weekday, and investigation place was rail transit, typical shopping center, residential area, express point and electric bike park lot respectively. In Nanjing Road and Zhongshan Park, there are 250 questionnaires, and 239 effective questionnaires had been got. In residential community, 231 effective questionnaires had been got with 250 copies. 20 delivery couriers were inquired about the transportation tools and 30 park lots were investigated in Putuo, Jiading, Yangpu, Changning district.

There are five parts in the questionnaire. (1) personal information(i.e. gender, age, income, family members); (2)vehicle characteristics(i.e. price, maximum speed, weight); (3)trip characteristics(i.e. trip distance, trip time, trip purpose); (4) history of using traffic tools(pervious vehicles, using time, choice reason, ect); (5)users' intention(i.e. attitudes to banning E-bike, possibility to bus).

After investigation, the users' scope, travel characteristics and vehicle parameters could be obtained. Comparison on the travel characteristics would be analyzed between electric bikes and over-standard electric bikes. Through different scenarios, we can explore the probability to shift to transit from over-standard electric bikes.

3. Results and Analysis

3.1. Proportion of over-standard electric bikes

Over-standard electric bikes, electric bikes and bicycles are mixed on the same facilities, and it inevitably leads to a complicated traffic flow and causes a series of problems. It is necessary to measure the proportion of over-standard electric bikes.

In this article, seven observation sites in Shanghai were chosen for this research, including transit stations, E-bikes park lots, communities and roads. From Tab.1, the proportion of over-standard electric bikes is shown. The proportion of over-standard electric bikes is nearly 57.37% which is calculated by the total data collected from 7

different samples. According to Tab.1, the conclusion that over-standard electric bikes are more than electric bikes was drawn.

Table 1. Proportion of over-standard electric bike in Shanghai

Position	over-standard electric bikes	electric bikes
Nanxiang Station	57.46%	42.54%
Yonghui Community	59.66%	40.34%
Taopu Community	54.17%	45.83%
Caoyang Station	51.76%	48.24%
Zhongshan Park Station	68.29%	31.71%
Longzhimeng	50.75%	49.25%
East Nanjing Station	62.50%	37.50%
Total	**57.37%**	**42.63%**

3.2. Comparison between over-standard electric bikes and electric bikes

As is known to us, electric bike is popular with a unique group due to its cheapness, convenience. It has also become useful and widespread in people's daily life. The amount of two-wheel electric vehicles has reached 120 million in the end of 2010. Nowadays, over-standard electric bikes swarm into the traffic system and shared a higher percent in the non-motorized traffic. So travel characteristics of over-standard electric bikes should be paid more attention.

Intuitively, Figure 1 shows that over-standard electric bikes provide a longer travel distance. The mean value of electric bicycle and over-standard electric bike is 6.35 and 7.61 kilometers respectively. Travel distance of e-bike concentrates on 1 to 10 km range, while over-standard e-bike is 1 to 20 km range. The reason to decide travel distance is the capacity of battery.

Currently there are two kinds of batteries for electric vehicles. One is 12Ah, and the other is 20Ah. If users want to travel 40 km, a 12Ah battery is enough. But for 70km, a 20Ah battery is needed. Over-standard electric bike has a wide body and carries portable a 20Ah battery. Therefore over-standard electric bikes attract more residents.

Travel time is shown from Figure 2 to Figure 3, which includes commuting trip and non-commuting trip. In commuting trip, e-bike and over-standard e-bike spends mean 17.14 and 20.96 min respectively. More people choose over-standard electric bike as long commuting time vehicle due to its faster speed. This is the exactly reason over-standard electric bike is widely used by people. In non-commuting trip, people prefer to use electric two-wheeler to go shopping and do some entertainment. The mean non-commuting time is 19.38 and 21 min for e-bike and over-standard e-bike.

In conclusion, over-standard electric bike is better than electric bike on speed and cruising distance, which lead to diffidence on the travel characteristics. There is a longer trip distance for over-standard e-bike and a shorted consuming time with the same distance. As a substitute of bike, electric bike share same features with the bike.

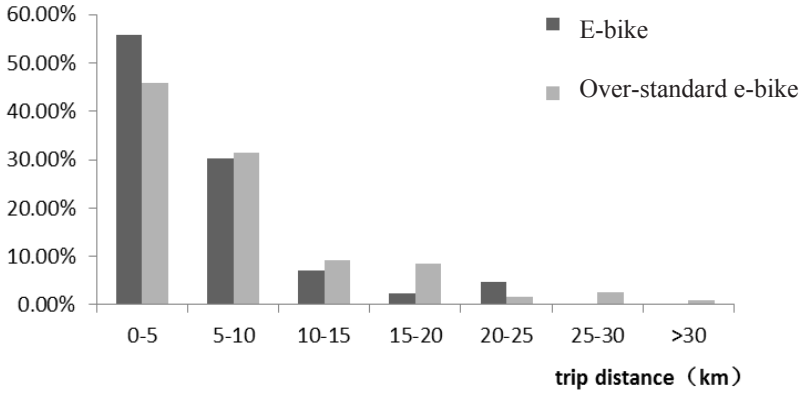

Fig. 2. Trip distance of e-bikes and over-standard e-bikes

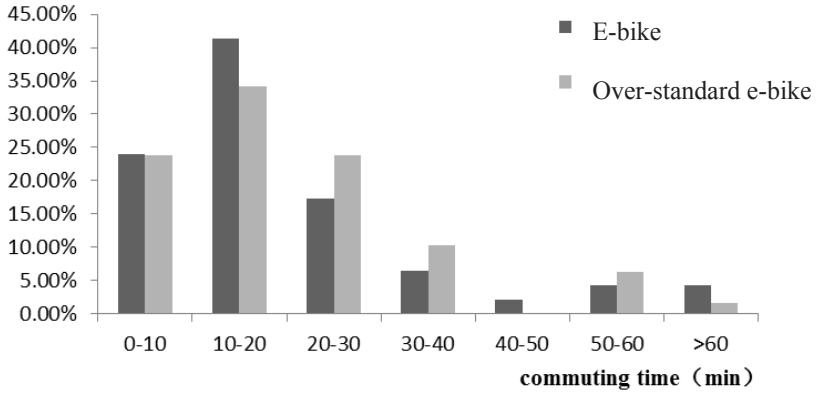

Fig. 3. Commuting time of e-bikes and over-standard e-bikes

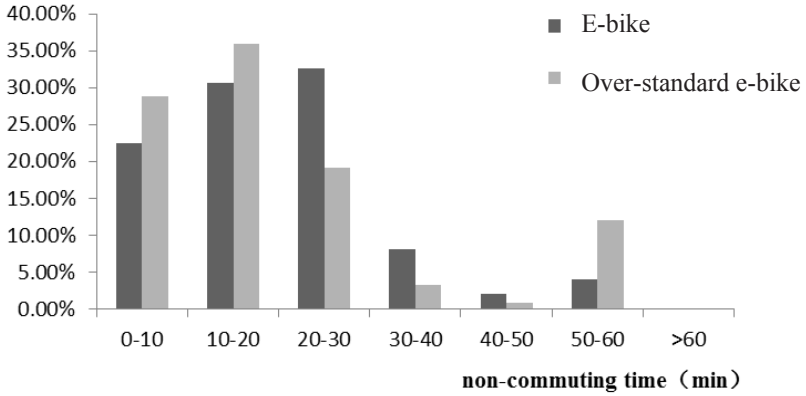

Fig. 4. Non-commuting time of e-bikes and over-standard e-bikes

The reason why people prefer to electric scooter is shown in the Figure 5. The bar chart presents an even distribution for over-standard electric bikes. It concentrates on the punctuality and time-saving. This figure reveals an important reason that over-standard electric bike is popular. It is the accessibility. Motorization is not only to meet the needs of economic development, but the demands of human development. It is a pursuit of mobility and comfort, which fundamentally determines the inevitability of over-standard electric bike popular.

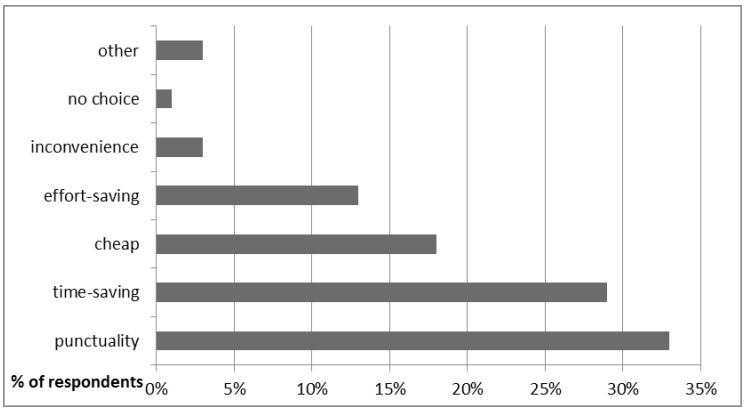

Fig. 5. The reason of selecting over-standard e-bikes

3.3. New change after banning over-standard electric bikes

Many cities started to ban or restrict over-standard electric bike. Some cities announced that over-standard electric bike was forbidden from production to sale. Some cities banned the entrance of over-standard electric bike into downtown regions and main roads. The alleged justifications of these bans include traffic congestion, improving safety and reducing environment pollution. Nowadays, more than fifty cities of China had banned over-standard electric bikes, and some of them banned electric bikes too.

The ban of over-standard electric bike has effect on the choice of traffic tools. Under the circumstances, a new choice of users is shown on the Figure 6. Nearly 50 percent will transfer to transit and 20 percent to bicycle. The users of over-standard electric bike prefer to motorized traffic and have more possibility to become car user.

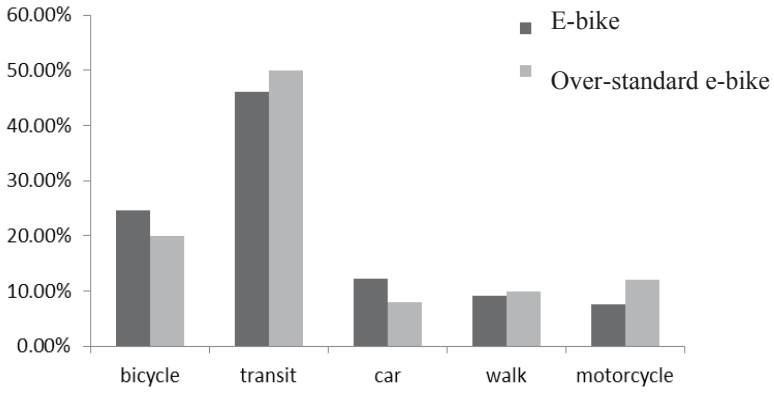

Fig. 6. Modal choice after banning over-standard e-bikes

In order to analyze the above phenomenon more qualitatively, the data of over-standard electric bikes users' past vehicle are used to explore how to change if over-standard electric bike is unavailable. Figure 7 shows the previous vehicles of the respondents. More than 80 percent users had switched from bicycle and public transport. There are 3 percent over-standard electric bike users who are switched from electric bike.

We draw the conclusion that there is a significantly competitive relationship among electric vehicles, bicycle and transit. The development trend of three vehicles presents as one falls, another rises. The development of electric vehicles is not isolated. It is the outcome that electric bikes compete and balance to other traffic modal, particularly transit.

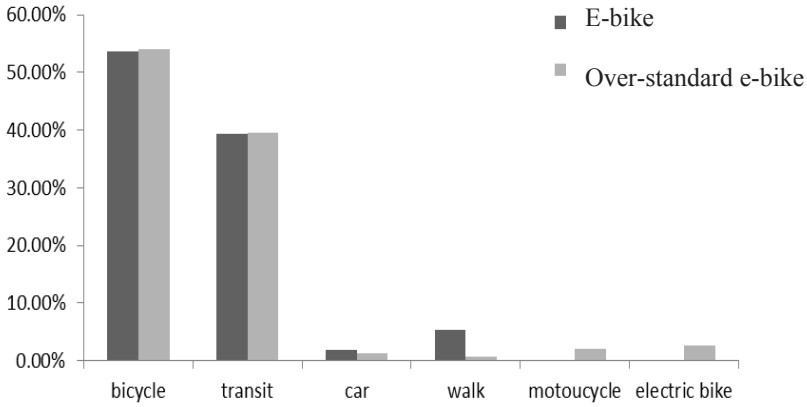

Fig. 7. The pervious vehicle of respondents

4. Conclusion

As cities grew, so did the demand and transportation. Regular bike cannot meet the requirements and electric two-wheeler use is experiencing tremendous growth. There is an over-standard electric bike which is faster and heavier than normal electric bike. Over-standard electric bike provides an low-cost and convenient form of private mobility and is thus an attractive alternative to public transit or regular bicycling. 70% users had switched from public transport and bicycle. However, the increasing numbers of over-standard electric bike have simultaneously created some serious problems affecting future prosperity: safety and efficiency.

This paper focuses on travel characteristics. More than 500 electric two-wheeler users are interviewed to collect characteristic data. Statistical analysis is used to analyze the differences between electric bike and over-standard electric bike.

When over-standard electric bike's characteristics are made comparison with electric bikes', the distribution has a few changes. The use of over-standard electric bike improves the level of service of two-wheeler traffic. There are a longer travel distance and a relatively long travel time. Over-standard electric bikes are still the dominant transport mode in both commuting trip and non-commuting trip. The main reason to choose over-standard electric bike is punctuality and time-saving. If the over-standard electric bikes are unavailable, 70 percent of the over-standard electric bike users will transfer to motorized traffic, such as transit and car.

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References

Chen, X., Han, H., and Ye, J. Normalized Volume Measurement for Non-Motorized Traffic Flow Mixed with Mopeds. Accepted for publication in Transportation Research Record: Journal of the Transportation Research Board, 2011 (in Print).

CHEN, Yan-yan, LIU, Xiao-ming, Hong, Feng. The Study of Electric Bike Development Strategy in Beijing. Road Traffic and Safety, 2002,4.

Cherry, C. and Cervero, R. Use Characteristics and Mode Choice Behavior of Electric Bikes in China. (Institute of Transportation Studies, University of California Berkeley, 2006).

Chi-Jen Yang. Launching strategy for electric vehicles: Lessons from China and Taiwan. Technological Forecasting & Social Change 77 (2010) 831–834.

Christophel Robin Cherry. Electric Two-wheelers in China: Analysis of Environmental, Safety and Mobility Impacts. University of California，Berkely. Spring 2007.

DONG, Bin-jie. The Study of Characteristics of Electric Bicycle[D]. School of transportation, Tongji University, 2008.

DONG, Fang. Pedelec is the Best Definition of Electric Bike[J]. China Bicycle, 2003, 3:24-26.

National standard of the People's Republic of China. Electric bicycles--General technical requirements. [M].GB17761-1999.6-8.

ZHANG, Cun-bao, YANG Xiao-guang, YAN Xin-ping. Traffic Data Collection System Based on Floating Cars [J] .Journal of Traffic and Computer, 2006, 24 (5) :31-34.